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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER

NGUYEN, HA T

ART UNIT	PAPER NUMBER
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2812

DATE MAILED: 07/31/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

09/653,561

Applicant(s)

HILLYER ET AL.

Examiner

Ha T. Nguyen

Art Unit

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 17 May 2002.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-4,6-32 and 34-53 is/are pending in the application.
- 4a) Of the above claim(s) 45-49 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-4,6-32,34-44 and 50-53 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☒ The proposed drawing correction filed on 5-17-02 is: a) ☒ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_\_ 6) ☐ Other: \_\_\_\_\_

## DETAILED ACTION

### *Notice to applicant*

1. Applicants' Amendment and Response to the Office Action mailed 01-17-02 has been entered and made of record (Paper No. 8).

### *Response to Amendment*

2. In view of Applicants' cancellation of the claims, the rejection of claims 5 and 33 under 35 U.S.C. 103 is rendered moot.

In view of Applicants' arguments and amendment to the claims, the rejection of claims 1-4, 6-32, 34-44, and 50-53 under 35 U.S.C. 102 or 103 in Paper No. 5, has been withdrawn.

Applicants are referred to the new ground of rejection given below.

### *Claim Rejections - 35 USC § 112*

3. Claims 15, 25, and 26 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 15 depends from cancelled claim 5.

Claims 25 and 26 variously depend from claim 5, they are rejected for the same reason.

### *Claim Rejections - 35 USC § 102*

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless --

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371<sup>®</sup> of this title before the invention thereof by the applicant for patent.

5. Claims 1-4, 6, 14, 16-20, and 22 are rejected under 35 U.S.C. 10<sup>2 e</sup><sub>3 (a)</sub> as being unpatentable by Smith ( U. S. Patent 6277733).

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[Claim 1] Referring to Figs. 1, 2a-2h and related text, Smith discloses a method for removing polymer etch residue from an etched opening in a semiconductor wafer device comprising: forming an opening 429 in an insulating layer, wherein a polymer etch residue remains within said opening after the opening forming step (see Fig. 2d and col. 4, lines 8-26); contacting said opening with a plasma generated from ammonia gas to remove said polymer etch residue (see col. 4, lines 8-26);

[Claim 16] contacting said opening with an oxygen containing plasma; stopping said oxygen plasma contacting before said polymer etch residue is completely removed and thereafter contacting said opening with ammonia gas (see col. 3, lines 36-47) ;

[Claim 2] wherein said opening is a HAR contact opening (see Fig. 2f);

[Claim 3] wherein said contacting is performed under conditions effective to remove said etch residue without substantially increasing the size of said opening (See col. 1, 54-56);

[Claims 4 and 18] wherein said opening is contacted with ammonia gas in the absence of oxygen (See col. 4, lines 8-48);

[Claims 6 and 20] wherein said contacting is done at a temperature within the range of about 250-500C (See col. 4, lines 33-43) ;

[Claim 14] further comprising forming a conductive layer at the bottom of said opening following said contacting step (see col. 4, lines 49-61);

[Claim 17] the arguments for the rejection of claims 2 and 3 apply;

[Claim 19] where said ammonia gas is in a plasma (See col. 3, lines 36-55);

[Claim 22] wherein said ammonia contacting is performed at a temperature of about 350C (see col. 4, lines 8-48).

### ***Claim Rejections - 35 USC § 103***

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

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This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103<sup>©</sup> and potential 35 U.S.C. 102(f) or (g) prior art under 35 U.S.C. 103(a).

8. Claims 7-13, 21, 23, 24, 27, and 28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Smith or Kawai in view of Smith.

Smith or the combined teaching of Kawai and Smith discloses substantially the limitations of claims 7-13, 21, 23, 24, 27, and 28, as shown above.

But Smith or the combined teaching of Kawai and Smith does not disclose the parameters for the ammonia plasma contacting step. However any variation in parameters in the present claims is obvious in light of the cited art, because the changes in parameters produce no unexpected function.

The routine varying of parameters to produce expected changes are within the ability of one of ordinary skill in the art. Patentability over the prior art will only occur if the parameter variation produces an unexpected result. In re Aller, Lacey and Hall, 105 U.S.P.Q. 233, 235. In re Reese 129 U.S.P.Q. 402, 406.

Therefore, it would have been obvious to use the teaching of Smith or the combined teaching of Kawai and Smith to obtain the invention as specified in claims 7-13, 21, 23, 24, 27, and 28.

9. Claims 29-32, 34-38, and 40-44 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kawai in view of Smith.

[Claim 29] Referring to Figs. 3A-3D, Kawai discloses a method of forming a contact opening in a semiconductor device, comprising: etching a contact opening 22 in an insulative layer 18 in said device down to a polysilicon<sup>14</sup> element of said device; and cleaning etch residue from said etched opening by contacting said opening with a gas (see col. 4, lines 4-58);

[Claim 40] further comprising contacting said opening with an oxygen plasma after said etching step (see abstract);

[Claim 41 ] wherein an insulating layer 18 is formed on said device prior to said etching and said etching forms a contact hole in said insulating layer;

[Claims 42-44] wherein in said etching is dry etching; wherein said dry etching is performed using at least one fluorine containing gas; and wherein said fluorine-containing gas is at least one gas selected from the group consisting of  $\text{CH}_2\text{F}_2$ ,  $\text{CHF}_3$ ,  $\text{C}_2\text{F}_6$ ,  $\text{C}_2\text{HF}_5$ , and  $\text{CH}_3\text{F}$  (see col. 4, lines 8-18).

But it does not disclose expressly the use of ammonia gas for cleaning etch residue and [Claim 30] wherein said contacting is performed under conditions effective to remove said etch residue without substantially increasing the size of said opening; [Claim 31] wherein said contacting is performed under conditions which do not oxidize said opening; [Claim 32] where said opening is contacted in the absence of added oxygen .

However, the missing limitations are well known in the art because Smith discloses this feature (See col. 4, lines 8-48 and col. 1, 54-56).

A person of ordinary skill is motivated to modify Kawai with Smith to obtain a more effective polymer residue cleaning etch.

[Claims 34-38] the arguments similar to the rejection of claims 7-13, 21, 23, 24, 27, and 28 apply.

Therefore, it would have been obvious to combine Kawai with Smith to obtain the invention as specified in claims 29-32, 34-38, and 40-44.

10. Claims 1, 2, 15, 25, 26, 39, and 50-53 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kawai in view of Smith and Hamada.

[Claims 1, 2, and 50] Referring to Figs. 3A-3D, Kawai discloses a method of forming an integrated circuit structure comprising: forming an insulating layer 18 over a polysilicon region 14; forming a contact opening in said insulating layer down to said polysilicon region using a fluorine containing gas (see col. 4, lines 4-18); removing polymer residue from said contact opening using a gas (see col. 4, lines 26-58);

[Claim 52] further comprising removing a portion of said polymer residue from said contact opening with oxygen;

But it does not disclose that the contact opening has HAR, the steps of removing polymer residue with plasma of ammonia gas, forming a titanium silicide at the bottom of said opening in contact with said polysilicon layer; forming a conductor in said opening in electrical contact with said silicide; and using said gas to remove polymer residue after using oxygen plasma); [Claim 25] wherein said ammonia contacting is performed for a period of time sufficient to remove said residue from a bottom of said opening; [Claim 26] wherein said bottom of said opening is not oxidized during said ammonia contacting.

However, the missing limitations are well known in the art because Smith discloses substantially all the missing limitations as shown above; and Hamada discloses forming a titanium silicide 111 at the bottom of said opening in contact with said polysilicon layer 104; forming a conductor 112 in said opening in electrical contact with said silicide (see Fig. 3D and col. 5, lines 1-20); wherein said ammonia contacting is performed for a period of time sufficient to remove said residue from a bottom of said opening (see col. 4, lines 8-48); wherein said bottom of said opening is not oxidized during said ammonia contacting step (see col. 4, lines 8-48)

A person of ordinary skill is motivated to modify Kawai with Smith and Hamada to obtain good cleaning and improved connection conductivity. Therefore, it would have been obvious to combine Kawai with Hopper and Hamada to obtain the invention as specified in claims 1, 2, 15, 25, 26, 39, and 50-53.

### ***Conclusion***

11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ha Nguyen whose telephone number is (703)308-2706. The examiner can normally be reached on Monday-Friday from 8:30AM to 6:00PM, except the first Friday of each bi-week.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, John Neibling, can be reached on (703) 308-3325. The fax phone number for this Group is (703) 308-7722.

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Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-0956.



Ha Nguyen  
Primary Examiner  
07- 25 - 02